DETAILED PROJECT REPORT

ON

ENERGY EFFICIENT GAS FIRED ROTOBERATORY FURNACE

(750 KG/BATCH)

(JAMNAGAR BRASS CLUSTER)











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ENERGY EFFICIENT GAS FIRED ROTOBERATORY FURNACE (750 kg/batch)

(JAMNAGAR BRASS CLUSTER)

BEE, 2010

Detailed Project Report on Energy Efficient Gas Fired Rotoberatory Furnace (750 kg/batch)

Brass SME Cluster, Jamnagar, Gujarat (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: ***JAM/BRS/EGR/06***

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Winrock International India

New Delhi

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List of Abbreviations

MT	Metric Tonne
kWh	kilo Watt Hour
GoI	Government Of India
MoMSME	Ministry of Micro Small and Medium Enterprises
GHG	Green House Gas
BEE	Bureau of Energy Efficiency
DPR	Detailed Project Report
O&M	Operational & Maintenance
NPV	Net Present Values
ROI	Return on Investment
IRR	Internal Rate Of Return
DSCR	Debt Service Coverage Ratio
PBT	Profit Before Tax
PAT	Profit After Tax
ID	Induced Draft
FD	Forced Draft
DBT	Dry Bulb Temperature
SIDBI	Small Industries Development Bank of India

EXECUTIVE SUMMARY

Winrock International India is executing BEE-SME program in Jamnagar Brass Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Jamnagar is known as the brass city of India, it has been an important industrial centre since long for brass related parts. All the units in Jamnagar Brass cluster had been operating in traditional conditions and most of equipments/utilities using in cluster were procured from the local suppliers. They are making the equipments on their traditional expertise, which had remained unchanged over the years. Hence this cluster was chosen for energy efficiency improvements by implementing energy efficient technologies, so as to facilitate maximum replication in other brass clusters in India.

Major energy sources being used in manufacturing of Brass parts in Jamnagar Brass cluster are electricity and fuels such as Coal, Furnace Oil and Liquid petroleum gas. This depends on application of technology, process requirement, availability, and economic and safety point of view. The two forms of energy being used in manufacturing of Brass parts in typical Brass unit are electrical energy and thermal energy. Electrical energy is being used in melting of Brass in induction furnaces, operation of electrical utilities and thermal energy is being used in Brass melting operation.

The function of coal fired pit furnace in brass industries is melting of raw material (Brass scrap), which is subsequently used in for pouring into different moulds to obtain various shapes. Performances of various coal fired pit furnace in Jamnagar Brass units are evaluated and analyzed the quantum of various losses in coal fired pit furnace were analyzed. It was observed that the coal fired pit furnace has poor efficiency due to poor combustion space, improper location & size of burners and improper capacity of blower system.

Implementation of proposed energy efficient rotoberatory furnace equipped with waste heat recovery system and automatic control system having efficiency more that existing furnace would save energy and replace total 192 tons coal consumption per year.

This DPR highlights the details of the study conducted for assessing the potential for replacement of conventional coal fired furnace by new energy efficient rotoberatory furnace , possible energy saving, and its monetary benefit, availability of the technologies/design, local service providers, technical features & proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, sensitivity analysis for three different scenarios and schedule of Project Implementation.

This bankable DPR also found eligible for subsidy scheme of MoMSME for "Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises" under "National Manufacturing and Competitiveness Programme". The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table:

S. No	Particular	Unit	Value
1	Project cost	₹(in Lakh)	20.63
2	Fuel consumption in base case (Coal)	tons/year	192
3	Gas consumption in proposed case	Nm^3/year	56250
4	Monetary benefit due to fuel change	₹(in Lakh)	20.94
5	Debit equity ratio	Ratio	3:1
6	Simple payback period	years	0.99
7	NPV	₹(in Lakh)	57.25
8	IRR	%	79.18
9	ROI	%	28.71
10	DSCR	Ratio	4.19
11	Process down time	Days	7
12	CO_2 reduction	Tons/year	384

The projected profitability and cash flow statements indicate that the proposed project implementation i.e. energy efficient gas fired rotoberatory furnace with existing coal fired furnace will be financially viable and technically feasible.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Jamnagar Brass Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up gradation through studies and pilot projects in these SMEs clusters.

***Major activities in the BEE -SME program are furnished below*:**

Activity 1: Energy use and technology audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Activity 2: Capacity building of stake holders in cluster on energy efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting of energy efficiency projects in the clusters

Activity 3: Implementation of energy efficiency measures

To implement the technology up gradation projects in clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Activity 4: Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion

1 INTRODUCTION

1.1 Brief introduction about Cluster

Jamnagar, known as the brass city of India, has been an important industrial centre since long for brass related parts. Jamnagar is inhabited by a various types of brass related work units which include Brass foundry; Brass parts manufacturing, Electroplating and Extrusion units. There are about 3500 brass related units alone in Jamnagar. Majority of these Brass units in Jamnagar are in operation since last 20 years. All these units are located in pockets of Shankartekri, MP Shah Udyognagar, Patel colony and Dared areas.

Jamnagar Brass cluster like many other clusters was in dire-straits with regard to the energy efficiency and conservation. In almost all units, whether big or small, there had been no conscious effort to take up energy conservation and energy efficiency measures as a part of day to day operations. Many a times, the small scale entrepreneur was not even aware of measures that could bring down the percentage energy cost, which automatically brings down the manufacturing cost. Some of the bigger units had experimented with few parameters to improve energy efficiency in the units, but the results and outcome was confined to them only. All the units in Jamnagar Brass cluster had been operating in traditional conditions and most of equipments/utilities using in cluster were procured from the local suppliers. They are making the equipments on their traditional expertise, which had remained unchanged over the years.

Till now there has been very little focus on energy conservation activities in the units. Also, there have been no concrete external interventions as well to help the small units come out of their shell and rise up to the necessary energy efficiency benchmarks. The raw material requirement of the Jamnagar Brass cluster is met mainly from the following three sources:

- Old brass, copper and bronze utensils
- Imported brass scrap and honey
- Brass scrap from ship breaking yard

Apart from the Brass scrap; copper, zinc, led, other metal alloys and clay etc are also used as raw material depends on the final product requirement

Majority of the raw material requirement in Jamnagar Brass cluster is met through imports. The countries from which it is imported are USA, Singapore, Gulf and European countries. The imported raw material is available mainly in three forms i.e. Honey scrap, Dross of brass & Pale in the form of strips.

1.1.1 Existing production process

The production process mentioned in the below chart is almost similar to most of brass part manufacturing units in the Jamnagar brass cluster. However, depending on the final product, quality of final product manufacturing unit and raw material properties, stated process flow is altered to suit the requirement of industry.

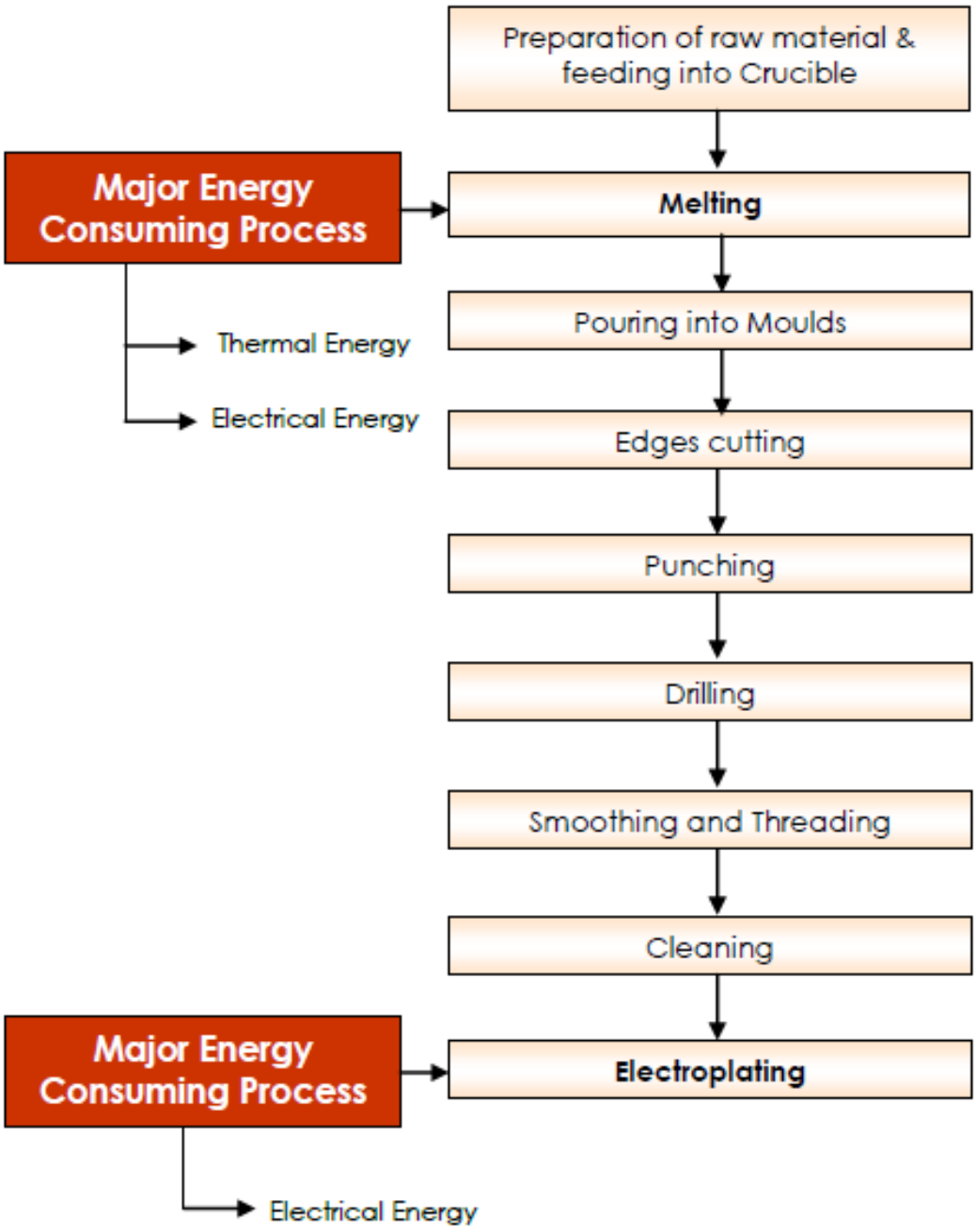

Figure 1.1: Process flow chart

1.2 Energy Performance in Jamnagar Brass Cluster

Major energy sources being used in manufacturing of Brass parts in Jamnagar Brass cluster are electricity and fuels such as Coal, Furnace Oil and Liquid petroleum gas. This depends on application of technology, process requirement, availability, and economic and safety point of view. The two forms of energy being used in manufacturing of Brass parts in typical Brass unit are electrical energy and thermal energy. Electrical energy is being used in melting of Brass in induction furnaces, operation of electrical utilities and thermal energy is being used in Brass melting operation.

Energy consumption (thermal energy & electrical energy) in Brass unit depends on type of unit and final product manufacturing in unit. Annual electrical energy and thermal energy consumption in typical Brass foundry, Extrusion unit, Machining and Electroplating unit is presented in below bar chart

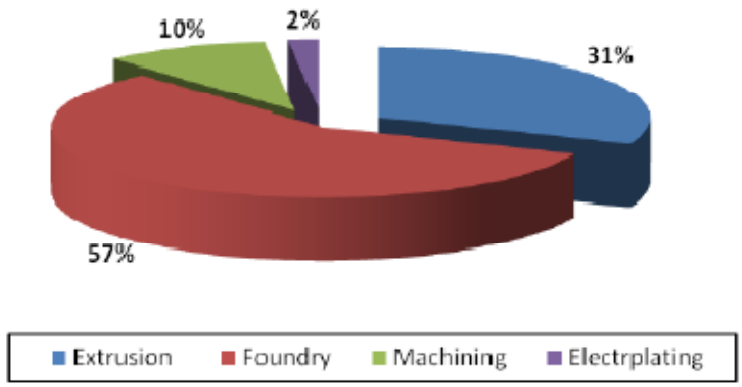

Figure 1.2: Percentage of energy consumption in different type of unit

1.2.1 Specific energy consumption

Specific electrical and thermal energy consumption in brass unit is varying on the final product manufactured in that unit. Specific energy consumption specific energy cost in different brass unit is shown in Table 1.1 & Table 1.2 below:

Table 1.1 Specific energy consumption in various brass units

S.No.	*Type of units*	*Unit*	*Value*
1	Brass foundry unit	kCal/kg of brass rod	1013-1057
2	Brass extrusion unit	kCal/kg of brass rod	1037-1186
3	Brass machining unit	kCal/kg of final product	473.04
4	Brass electroplating	kCal/kg of final product	875.21

Table 1.2 Specific energy cost in various brass units

S.No.	Type of units	Unit	Value
1	Brass foundry unit	₹/kg of brass rod	3.17-3.02
2	Brass extrusion unit	₹/kg of brass rod	5.64-5.194
3	Brass machining unit	₹/kg of final product	3.24
4	Brass electroplating unit	₹/kg of final product	5.99

1.3 Identification of existing technology/ equipment

1.3.1 Description of equipment

Majority of Brass units in Jamnagar Brass cluster are using low end technologies in their processes and utilities. The performance of those processes/equipments is poor as compared to the technologies available in the market. Performances of various coal fired pit furnace in Jamnagar Brass units are evaluated and analyzed the quantum of various losses in coal fired pit furnace were analyzed. It was observed that the coal fired pit furnace has poor efficiency due to poor combustion space, improper location & size of burners and improper capacity of blower system etc. It is recommended to replace conventional coal fired furnace with energy efficient gas fired rotoberatory furnace.

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Figure1.3 Conventional Coal fired furnace operations

From energy use and technology gap audit studies in various brass industries in Jamnagar brass cluster, below mentioned things are identified:

- Energy efficiency improvement opportunities
- Environment and safety improvement of workers
- Design flaws in the conventional coal fired pit furnace
- Operational & maintenance practices in conventional coal fired pit furnace

1.3.2 Technical gap in conventional pit furnace

Technology gaps/design flaws in conventional coal fired pit furnace system are identified and same is presented in detail below:

➢ **Waste heat recovery system**

From energy use & technology audit studies it was observed that, there is no waste heat recovery system to recover the heat losses from hot flue gasses in pit furnaces. The energy audit study reveals that the amount of heat loss in flue gas of pit furnaces is around 35% of total energy input.

➢ **Preheating of charge/air**

In majority of the systems it was observed that, there is no system to preheat the charge and / or air. Preheating of charge to around 200-300 deg C will reduce the energy consumption by 5-8%.

➢ **Insulating material**

Furnace lining of the existing furnace is with locally available firebricks. The locally available firebrick contains low alumina and gets worn out in a short duration. Also, the insulation required for plugging heat loss through the pit furnace was usually done with locally available red bricks, which do not serve the purpose of insulation.

➢ **Combustion space**

From technology audit it was observed that combustion space in existing system is insufficient to hold proper combustion, which causes poor combustion system efficiency**.**

➢ **Burners**

Majority of units are using locally fabricated burners for the combustion of fuel. These burners were either a copy of a properly designed burner or sometimes substandard and locally designed.

➢ **Selection and size of Blower system**

A proper capacity blower is necessary for combustion air to be delivered at correct pressure and in appropriate volume. The existing blowers in majority of the units are

either locally fabricated without any proper design parameters or are under/over- sized without any consideration for correct air pressure.

- **Inadequate sizing of heating and pumping unit**

In most of the units it was observed that heating and pumping system are not designed properly. This is mainly due to lack of awareness about the standard fuel temperature and pressure at the combustion stage and the benefits thereof.

1.3.3 Specification of exisitng furnace

Detail specification of existing coal fired furnace is not available.

1.3.4 Role in the process

The function of coal fired pit furnace in brass industries is melting of raw material (Brass scrap), which is subsequently used in for pouring into different moulds to obtain various shapes. It is evident that melting of Brass scrap is one of the major energy and time consuming process in the overall manufacturing process in brass industry. Apart from the energy and time, final product quality will depend on time and temperature of raw material melt.

1.3.5 Need for up gradation of existing equipment

The melting cost is one of the major costs in the overall production process of brass, in typical brass industry which comes out to be ₹ 28/kg, which is approximately 20% of overall energy cost. Apart from the high energy cost, melting time is one of the major time consuming process in brass industry, this would be around 1.2– 1.5 hours per melt.

Advantages of replacing the conventional coal fired pit furnace system with Energy Efficient gas fired rotoberatory furnace are:

- Reduction in specific energy consumption
- Improved productivity and product quality
- Reduction in specific energy cost
- Improves working environment
- Preheating of charge will reduce fuel consumption

1.4 Baseline energy consumption of existing equipment

Energy consumption in coal fired pit furnace would depend on items mentioned below:

- Melting time
- Temperature of melt

- Fuel consumption
- Operational and maintenance practices in agitator system
- Location and size of burner

Energy use and technology audit studies were conducted in various units of Jamnagar brass cluster to establish the baseline energy consumption of coal fired pit furnace and the reports for the same are attached as Annexure – 1.

1.4.1 Design and operating parameters

Major operational parameters improvements in gas fired pit furnace performance are:

- Improve heat and mass transfer area
- Capture waste heat through waste heat recovery system
- Appropriate burner size and location of the burner
- Installation of temperature control device
- Choose appropriate size of blower system

1.4.2 Specific fuel consumption

Fuel consumption of typical coal fired pit furnace of capacity 255 kg/batch is around 192.16 kg/tons of production. Performance of existing coal fired pit furnace was evaluated and same is presented in Annexure 1.

1.4.3 Energy audit methodology

Predefined methodology was adopted to evaluate the performance of coal fired pit furnace, same was furnished below:

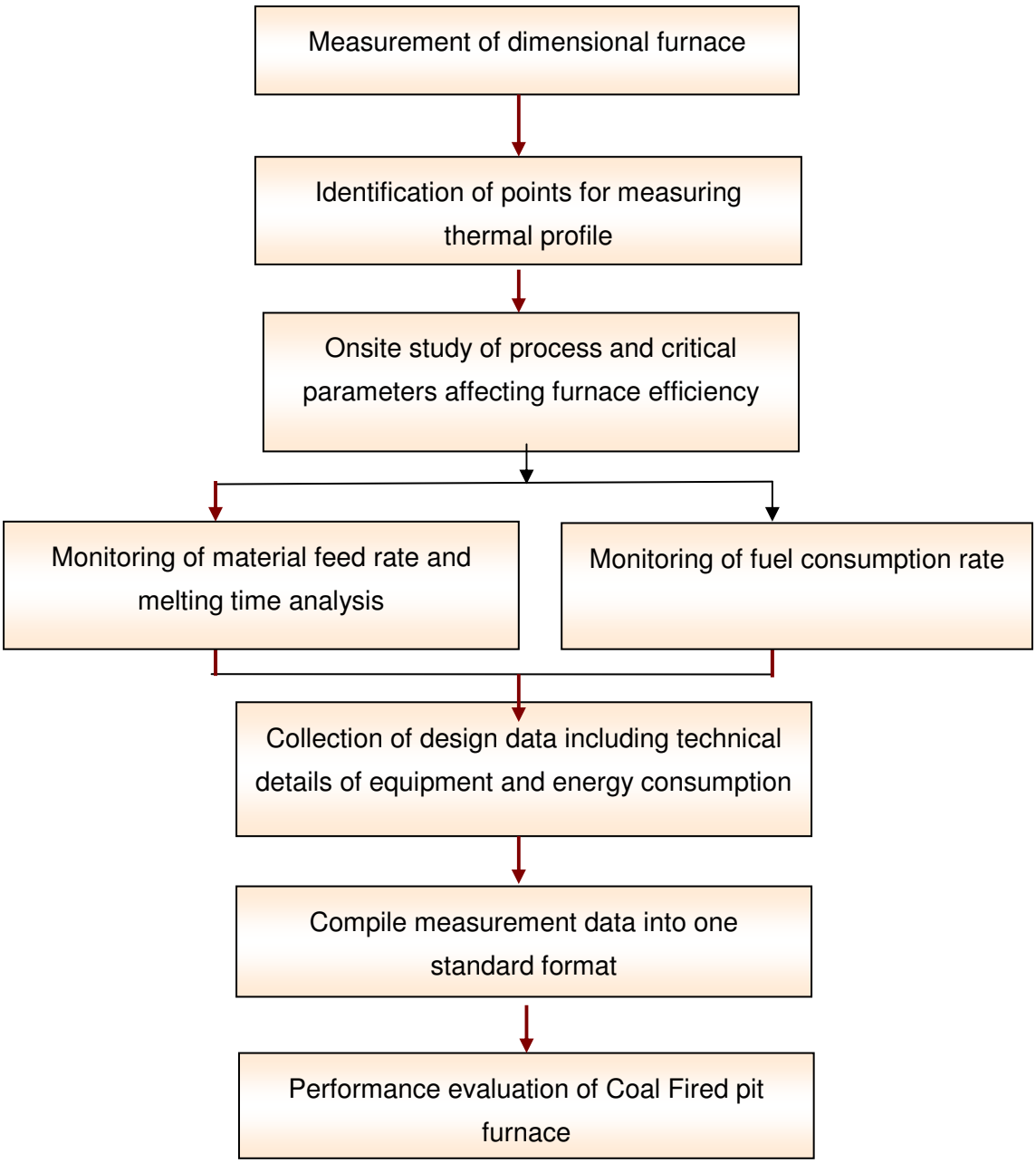


Figure1.4: Energy audit methodology

1.5 Barriers in adoption of proposed technology/equipment

The processes to do with technology and innovations in SMEs are different from those that take place the large firm context. Technology in the SME sector has an increasingly complex or combinative character, most of the SMEs units in cluster are regarded for their labour intensive and the capability work with local resources. In the past, SME entrepreneurs are stressed less emphasis on technology due to cut the initial cost of plant /machinery. Major barriers in the up gradation of technology in the cluster are non availability of technology;

distrust on technology supplier, lack of information about energy efficiency among small and medium enterprises still persists, preventing increased adoption of efficient technologies and non availability of skilled manpower and cost of new technologies. Details of the other barriers in the implementation of energy efficient technologies/equipments in the Jamnagar Brass cluster are presented in below sections.

1.5.1 Technological Barrier

A majority of the entrepreneurs in cluster are not aware of the energy losses in the plant, there may be a strong feeling that the energy efficiency initiatives in manufacturing facility can have a cascading effect of failure in critical production areas directly or indirectly connected if the intended performance of the replaced / retrofitted equipment falls below design values.

There is a strong feeling in the Brass unit entrepreneurs that, energy efficiency initiatives are difficult and they do not wish to take the risks such as business interruption due to production loss vis-a-vis the drive to save energy. These issues maybe overcome by motivating them to attend the awareness programs and use the detailed report on the benefits of the measures identified and cost benefit analysis. Further, sourcing of expertise on maintenance service provider or training by the equipment supplier will definitely overcome the barriers.

1.5.2 Financial Barrier

Significant amount of investment is not commonly seen in most of Jamnagar Brass industries. Further, from the business perspective for any industry owner, it is more viable, assured and convenient to invest on project expansion for improving the production capacity, rather than make piecemeal investment in retrofit and replace options for energy savings. Investment returns on large capacity addition or technology adoption shows up prominently in terms of savings and helps in benchmarking operations. Further, there is a strong feeling among the industry owners that, energy conservation initiatives of replacement and retrofit nature is not a common practice as it involves large capital investment against low returns. In view of this, and given the limited financial strength of entrepreneurs from Brass units in Jamnagar, they would not take the risks to invest in energy efficiency measures.

1.5.3 Skilled manpower

Skilled workers are locally available to run the furnace available in Jamnagar. However, there is hardly any engineer employed in these enterprises and the production process remains traditional. This is one of the lacunae of the Jamnagar Brass Parts cluster.

Specialized training with local service providers for better operation and maintenance of equipments, importance of the energy and its use will create awareness among workforce. These programs should be organized with equipment suppliers.

2 EQUIPMENT OPTION FOR ENERGY EFFICIENCY IMPROVEMENT

2.1 Description of proposed equipment

Since the present process is an outdated process and consumes lot of fuel & emits very high volume of carbon in it`s different forms, this process should be gradually phased out with the alternate process which should be

- cost effective, with a very little payback period,
- technically simple & yet superior, easy to understand & adopt, and
- highly eco friendly

The rotoberatory furnace fulfils all the above parameters compared to other technologies. The gas based (with a multi-firing option) rotoberatory furnace brass melting process has many distinct advantages like,

- The exhaust gases are passed through the recuperator & utilize for pre-heating of raw material & there by substantially saving the fuel.
- Due to pre-heating, slurry formation & rotary movements, the temperature increases uniformly & reduces the burning losses of precious metals by 70-75 %.
- Direct firing eliminates use of crucible, hence fuel consumption goes down substantially compared to indirect firing.
- This furnace has a motorized or hydraulic tilting system, to pour the molten metal. This, not only avoids direct exposure of labours to high temperature & fumes but also eliminates the highly dangerous & tedious process of lifting of crucible to pour the molten mass after every batch and to clean the ash of coal daily from the underground furnace . The dust collector is also essential which is not incorporated in the present ongoing process.
- Automation of filling of moulds is necessary to synchronise the melting of each batch timings with downtime process. Otherwise ,not only the time gap would be more between two batches, the fuel cost also increases due to loss of heat during the manual filling operations.
- The usage of gas in place of coal & proper slag removing system, will also improve the finishing &fineness of the finished products.

- If we cool & set the molten mass using water cooling technology, as adopted in aluminium & other metals, the problem of brass & other metals going into the dumping yard along with the moulding clay, could be solved.
- Contrary to recent ongoing, obsolete process & even newly adopted induction furnace (which is very costly) by few industries, this process is a closed process and thereby reduces the direct exposure of labours to heat, fumes, and poisonous gases
- Gas is available in plenty in India and we don't have to depend on foreign exchange, or on other countries. Due to domestic availability, the cost of fuel will not depend much on international market conditions.

All above mentioned factors justifies the process up gradation

2.1.1 Comparison of conventional with new rehating furnace

Technical, economic, Environmental, safety aspects of conventional furnace and energy efficient gas fired rotoberatory furnace are compared on life cycle of equipment, same is presented in Table 2.1 below:

Table 2.1 Comparison of conventional equipment and proposed equipment

S. No	Details	Conventional coal fired pit furnace	Energy efficient gas fired rotoberatory furnace
1	Fuel consumption	High	Low
2	Environment pollution	High (*partial combustion & more fuel consumption*)	Low (*Complete combustion & less fuel consumption*)
3	Safety of workers	Poor	Good
4	Maintenance	High	Low
5	Operational cost	High	Low
6	Availability of local service providers	Yes	Yes
7	Fuel combustion	Partial	Complete
8	Control of air/fuel combustion	No	Yes
9	Temperature monitoring & control	No	Yes
10	Radiation losses	More	Less
11	Radiation heat in combustion chamber	Not utilized	Utilized in the transfer of heat

From the above table it is clear that Energy efficient rotoberatory furnace has significant advantages in Energy, Environmental, Economic & safety aspects. It is technically

justifiable to install energy efficient rotoberatory furnace in place of conventional coal fired pit furnace.

2.1.2 Suitability over existing system

The proposed equipment is completely replaced the existing system and suitable with the existing process.

2.1.4 Technical specifications

Specification for energy efficient gas fired rotoberatory furnace varies from industry to industry and can be provided to vendor as per the need. A general specification of new furnace is furnished in Table 2.2 below:

Table 2.2 Technical specifications

S. No	*Details*	*Units*
1	Equipment	Rotoberatory Tilting Type Melting Furnace
2	Capacity	750 kg/Batch
3	Operating Temp.	1050° C
4	Max. Temp.	1350° C
5	Fuel	LPG/CNG/FO
6	Burner	6563-3
7	Gas Train	Semi automatic with 20 Cylinder Bank
8	Temp Control	Modulating Valve &Ratio Control valve
9	Blower	2 HP
10	Gas Consumption	40-45 kg/Ton
11	Chimney	10 Feet from Ground Level
12	Tilting Arrangement	Mechanical
13	Recuperator	5 HT
14	Batch time	1.5 hr

2.1.5 Superiority over existing system

Energy efficient gas fired Rotoberatory furnaces are available with waste heat recovery and equipped with designed burners with air fuel ratio control which make proposed furnace more efficient.

2.1.6 Availability of proposed equipment

The technology identified for implementation is available locally and are indigenously produced. The technology/ equipments will be procured from local equipment suppliers. The proposed equipment is locally manufactured by well known vendor in Jamnagar brass cluster for making energy efficiency equipments in cluster.

The equipment identified is available in the State of Gujarat (Jamnagar) and implemented successfully in few units in the cluster. The investment required for implementation of the identified measures has good financial returns and the proposed measure is technically and financially viable.

2.1.7 Equipment providers

Technology/service provider selected for implementation of the proposed energy efficiency project has long years of experience in implementation of energy efficiency projects. This technology/service provider is having in house R&D team to develop the new technologies / equipments, which are energy efficient & eco friendly. Recommended supplier having the trust in cluster on products developed by them. Details of equipment suppliers are furnished in Annexure 7.

2.1.8 Terms and conditions in sales of Energy efficient rotoberatory furnace

The technology/ service provider are providing performance guarantee for the products supplied and warranty for a period of one year for any manufacturing defects. The terms of sales from the proposed supplier is presented in the table below:

Terms and conditions for sale of energy efficient gas fired rotoberatory furnace is furnished in table below:

Table 2.3 Term and condition for supply of equipment

Scope of Supply	Rotoberatory motorized tilting furnace of 750 kgs batch size, 1 set of multi fire burner-nozzle& blower. Recuperator with compressor, Hoper with pre-heater system, Chimney, Dust collector. Electric Panel board.
Taxes & Duties	Vat will be charged extra. Freight is not included in the price.
Payment	Order will be accepted on receipt of 50% advance d.d., next 20% at the time of dispatch, another 20% on completion of commissioning & remaining 10 % on satisfactory final results.

Delivery	M/C will be supplied within 6-8 weeks from the date of acceptance of order.
Exclusion	All foundation bolts, civil engineering, foundation & electrical work of any nature whatsoever and materials required for such purpose. Detailed civil engineering drawing to suit soil conditions to be prepared by the client based on the foundation drawings showing pocket position and loading data supplied.

2.2 Process down time during implementation

The process down time for implementing the replacement of conventional furnace with energy efficient furnace will take one week. The implementation can be taken up during weekly holiday, or other holidays, so that the process down time can be reduced.

2.3 Suitable unit for proposed equipment

The suitability of proposed unit depends upon client confirmation about the furnace capacity and physical properties of material to be melted. A furnace of 750 kg/batch is suitable for a unit with 1000 tonnes per annum capacity.

3 ECONOMIC BENEFITS OF NEW EQUIPMENT

Energy use and technology audit studies were conducted in various units of the Jamnagar brass cluster to evaluate the performance of existing furnace, technical gaps in existing furnace and analyzed energy, economic, environmental and social advantages of energy efficient rotoberatory furnace over conventional pit furnace.

3.1 Energy & monetary benefits

3.1.1 Fuel Saving

Energy use and technology audit studies it was observed that energy consumption of coal fired pit furnace depends on the type of fuel, number of burners and temperature of furnace. Analysis was carried out on conventional coal fired pit furnace average fuel consumption from various energy use and technology audit studies in brass units in Jamnagar brass cluster; it comes out to be 192.16 kg/tonne. Fuel consumption of proposed energy efficient gas fired rotoberatory furnace is 56.25 Nm3/tonne. Total annual production capacity is 1000 tons hence, total 192 tons coal consumption would be replaced by gas and total gas consumption would be 56250 Nm^3 per year.

3.1.2 Electricity saving

Project implementation will not save electricity while its implementation will increase electricity consumption of about 2984 kWh per year.

3.1.2 Monetary benefit

Annual monetary savings due to implementation of energy efficient rotoberatory furnace is about ₹ 20.94 lakh per annum. Details of monetary saving and fuel saving calculation are furnished at Annexure 3.

3.2 Environmental benefits

3.2.1 Reduction in fuel consumption

Most of units in the cluster are using coal for pit furnace; by implementing the proposed energy efficient gas fired rotoberatory furnace in place of conventional furnace will eliminate coal consumption.

3.2.2 GHG emission reductions

Specific energy consumption of proposed energy efficient gas fired rotoberatory furnace is less than conventional furnace; it automatically leads to reduction of GHGs emissions by implementing proposed energy efficiency rotoberatory furnace in place of conventional

furnace. Reduction of GHGs emissions leads to improved environment and better compliance with environmental regulations.

3.2.2 CDMability of the project

The proposed project saves about 192 tons of coal per year for one furnace. This roughly corresponds to 499 tonnes of CO_2 emission reduction and the use of natural gas will generate 114 tonnes of CO_2 (56250 Nm^3 of gas consumption per year).The net CO_2 emission reduction will be around 384 tonnes or 384 CERs. Considering, at the cluster level 200 units apply this technology then the total savings would be about 76800 CERs per annum which can be a suitably sized small scale CDM project.

3.3 Social benefits

3.3.1 Impact on working environment

Replacement of conventional furnaces with energy efficient furnaces will reduce furnace skin temperature, closed combustion chamber & temperature control of gas fired rotoberatory furnaces, all those things will improves the working condition & safety of workers near to furnace.

3.3.2 Impact on manpower skills

Proposed energy efficient gas fired rotoberatory furnace components were procured from other companies and also generate employment during installation and commissioning. As training will be provided by equipment suppliers will improve the technical skills of manpower required for operation of the equipment.

3.3.3 Impact on wages/emoluments

The awareness among the technologies and training retained during implementation of the project will lead to increase the wages of the employees indirectly, as it improves the technical skills of the workforce during operation and maintenance of equipments. Further, the remuneration will improve in the market or in other companies for the work force.

3.4 Other benefits (If any)

3.4.1 Productivity improvements

Due to improved design of gas fired rotoberatory furnace will improves melting temperature; this automatically reduces melting time of brass. It was observed that melting is one of major time consuming area, reduction in cycle time and specific fuel consumption in brass manufacturing unit will improve productivity of the units in Jamnagar brass cluster.

3.4.2 Quality improvements

Most of the brass manufactured in Jamnagar brass industries is temperature sensitive. As already discussed in above chapters that inbuilt design of automatic temperature control system in energy efficient gas fired rotoberatory furnace will control temperature of material inside the furnace, this automatically improves quality of material.

3.4.3 Easy operation& maintenance

Operation and maintenance of new energy efficient gas fired rotoberatory furnace is easy and economical.

4 ECONOMICS & IMPLEMENTATION OF NEW SYSTEM

4.1 Cost of project implementation

4.1.1 Equipment cost

Technical and financial quotations of proposed energy efficient gas fired rotoberatory furnace are collected from reputed vendors. Cost of furnace having production capacity of 750 kg/hr is ₹ 18.75 lakh only as per the quotation provided at Annexure 8.

4.1.2 Other cost

Erection & commissioning cost is ₹ 1.88 lakh only. Details of project cost are furnished in Table 4.1 below:

Table 4.1 Details of proposed equipment installation cost

S.No	Particular	Unit	Value
1	Equipment cost	₹ (in Lakh)	18.75
2	Erection & Commissioning cost	₹ (in Lakh)	1.88
3	Other misc. cost	₹ (in Lakh)	0.00
4	Total cost	₹ (in Lakh)	20.63

4.2 Arrangement of funds

Proposed financing for the replacement of conventional furnace with energy efficient furnace is made considering a debt equity ratio of 3:1, which is normally allowed by financial institutions for financing energy efficiency projects. On the basis of debt equity ratio of 3:1 the promoter's contribution works out to 25% of the project cost and the balance would be term loan from the Bank / FIs.

4.2.1 Entrepreneurs contribution

Total cost (Equipment and erection& commissioning) of project works out to be ₹ 20.63 lakh. Out of which entrepreneur's contribution is 25%, which work out to be ₹ 5.16 lakh.

4.2.2 Loan amount

75% of the project cost would be available as term loan from the banks/financial institutions, which works out to be ₹ 15.47 lakh.

4.2.3 Terms & conditions of loan

The interest rate is considered at 10% which is SIDBI's rate of interest for energy efficient projects. The loan tenure is 5 years excluding initial moratorium period is 6 months from the date of first disbursement of loan.

4.3 Financial Indicators

4.3.1 Cash flow analysis

Profitability and cash flow statements have been worked out for a period of 8 years, being period, with in which the entire term loan would be repaid. The financials have been worked out on the basis of certain realistic assumptions, which are outlined below

- The project is expected to achieve monetary savings of ₹ 20.94 lakh per annum.
- The operational and Maintenance cost is estimated at 4% of cost of fixed assets with 5% increase every year to take care of escalations.
- The erection and commissioning charges is estimated at 10% of the total project cost for the plant and machinery
- Interest on term loan is estimated at 10%. The tenure of the loan is considered 5years and repayment starts after 6months from the first date of disbursement of loan in 60 monthly installments.
- Depreciation is provided as per the rates provided in the companies Act.
- Income tax provision is made as per IT Act 1961.
- Based on the above assumptions, profitability and cash flow statements have been prepared.

4.3.2 Simple payback period

Simple payback period of replacing conventional furnace with energy efficient furnace is 0.99 year.

4.3.3 Net Preset Value (NPV)

The Net present value of the investment on project is at @10.00% interest works out to ₹ 57.25 lakh.

4.3.4 Internal rate of return (IRR)

After tax Internal Rate of Return of the project is works out to be 79.18%. Thus the project is financially viable.

4.3.5 Return on Investment (ROI)

The average return on investment of the project activity works out at 28.71%.

Details of all the financial parameters for the replacement of conventional furnace with energy efficient furnace are presented in Table 4.2 below:

Table 4.2 Financial parameters of energy efficient furnace

S. No	Parameter	Unit	Value
1	Simple payback period	Years	0.99
2	NPV	₹ in lakh	57.25
3	IRR	%age	79.18
4	ROI	%age	28.71
5	DSCR	Ratio	4.19

4.4 Sensitivity analysis

In different situation fuel saving may increase or decrease on the basis of this scenarios a sensitivity analysis in realistic, pessimistic and optimistic scenario has been carried out which is as under

- Fuel saving increased by 5%
- Fuel saving decreased by 5%

Table 4.3 Sensitivity analysis

Particulars	IRR	NPV	ROI	DSCR
Normal	79.18%	57.25	28.71%	4.19
5% increase in fuel savings	82.98%	60.96	28.94%	4.39
5% decrease in fuel savings	75.35%	53.54	28.45%	3.99

Assuming all provision and resource input would remain same during sensitivity analysis

4.5 Procurement and implementation schedule

Total time required for implementation of proposed project is about 13 weeks from the date of financial closure. Detailed procurement and implementation schedules are furnished at Annexure 6.

ANNEXURE

Annexure-1 Energy audit reports of conventional pit furnace

Energy Audit Report of Coal fired Pit Furnace Report at Unit-1:

Coal fired pit furnace is the one of the major energy consuming equipments in production process of brass in Unit-1.

There are two methods to find out the efficiency of the furnace i.e.

- Direct method
- Indirect method

The indirect method covers various heat losses like dry flue gas loss, radiation loss, loss due to hydrogen in fuel etc. However, it was not possible to calculate the efficiency by indirect method due to lack of proper arrangements and poor design. Therefore, the furnace efficiency has been calculated by Direct Method only

Calculation of coal fired pit furnace efficiency Industries by direct method at Unit-1

Total Material Melt	Kg	295
Temperature of Material at Furnace Entry	deg C	34.2
Temperature of Molten Material	deg C	990
Difference in temperature	deg C	955.8
Specific Heat of the Material	Kcal/Kg degc	0.09
Sensible Heat absorbed by the Material	Kcal	25,376.49
Latent heat fusion of Brass	Kcal/kg	35
Latent heat of molten Brass material	Kcal	10,325
Total heat absorbed in Brass molten material	Kcal	35,701
Total Fuel Consumption	Kg	43
Calorific Value of the Fuel	Kcal/Kg	6,500
Total Heat to the Furnace	Kcal	279,500
Furnace Efficiency	%	12.77

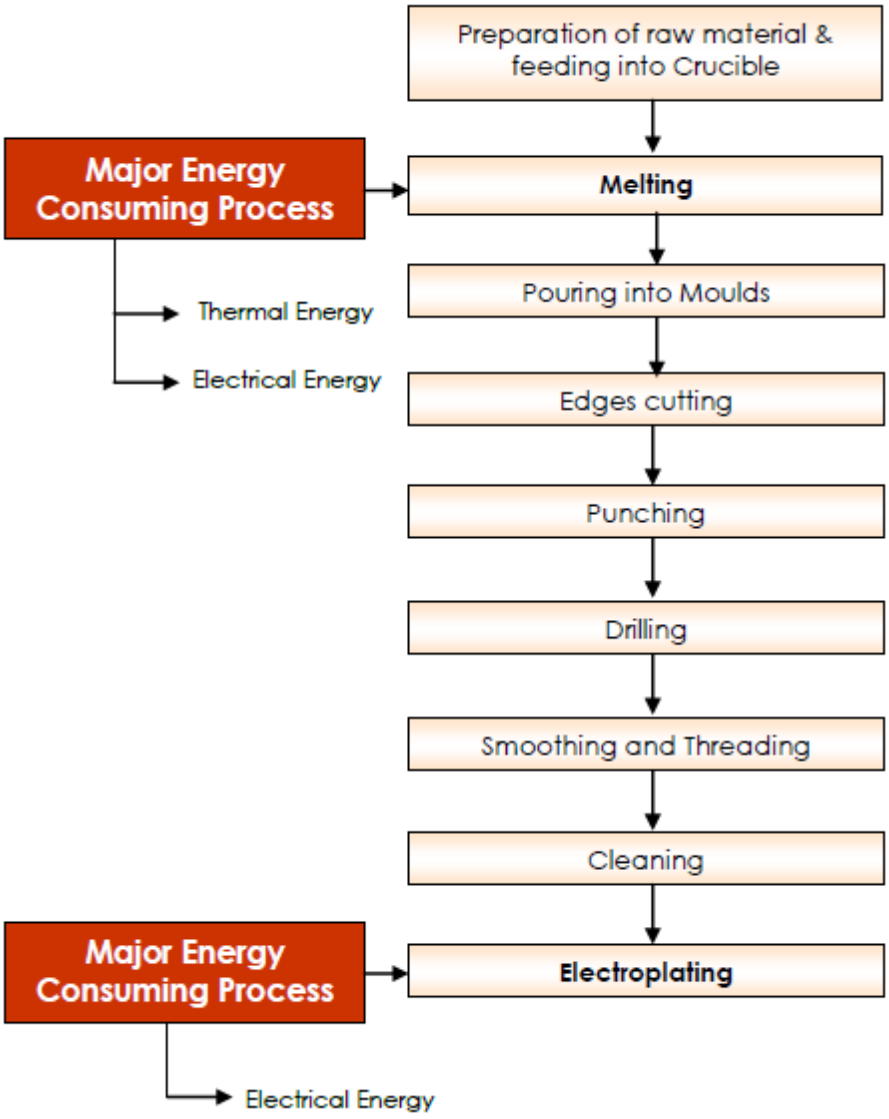
Energy Audit Report of Coal fired Pit Furnace Report at Unit-II

Calculation of coal fired pit furnace efficiency Industries by direct method at Unit-II

Total Material Melt	Kg	255
Temperature of Material at Furnace Entry	deg C	30.7
Temperature of Molten Material	deg C	990
Difference in temperature	deg C	959.3
Specific Heat of the Material	Kcal/Kg degc	0.09
Sensible Heat absorbed by the Material	Kcal	22015.94
Latent heat fusion of Brass	Kcal/kg	35
Latent heat of molten Brass material	Kcal	8925
Total heat absorbed in Brass molten material	Kcal	30940.94
Total Fuel Consumption	Kg	49
Calorific Value of the Fuel	Kcal/Kg	6500
Total Heat to the Furnace	Kcal	318500
Furnace Efficiency	%	9.71

Annexure 2 Process flow diagram

Process flow diagram of typical brass unit is same even after implementation of proposed furnace



Annexure-3 Detail technical assessment report

Brass manufacturing units in unorganized sector has these characteristics; low engineering, limited technology innovation, poor R&D base, low level of human resource on knowledge of technology and operational skill etc. This sector also faces deficiencies such as the lack of access to technology, technology sharing, lack of strong organizational structure, professional attitude etc.

Majority of Brass units in Jamnagar Brass cluster are using low end technologies in their processes and utilities. The performance of those processes/equipments is poor as compared to the technologies available in the market. There are various technological gaps which were identified in units as under:

- Lack awareness on the technologies available
- Lack of awareness on quantum of energy loss and its monetary benefit
- Lack of awareness among the workforce etc.

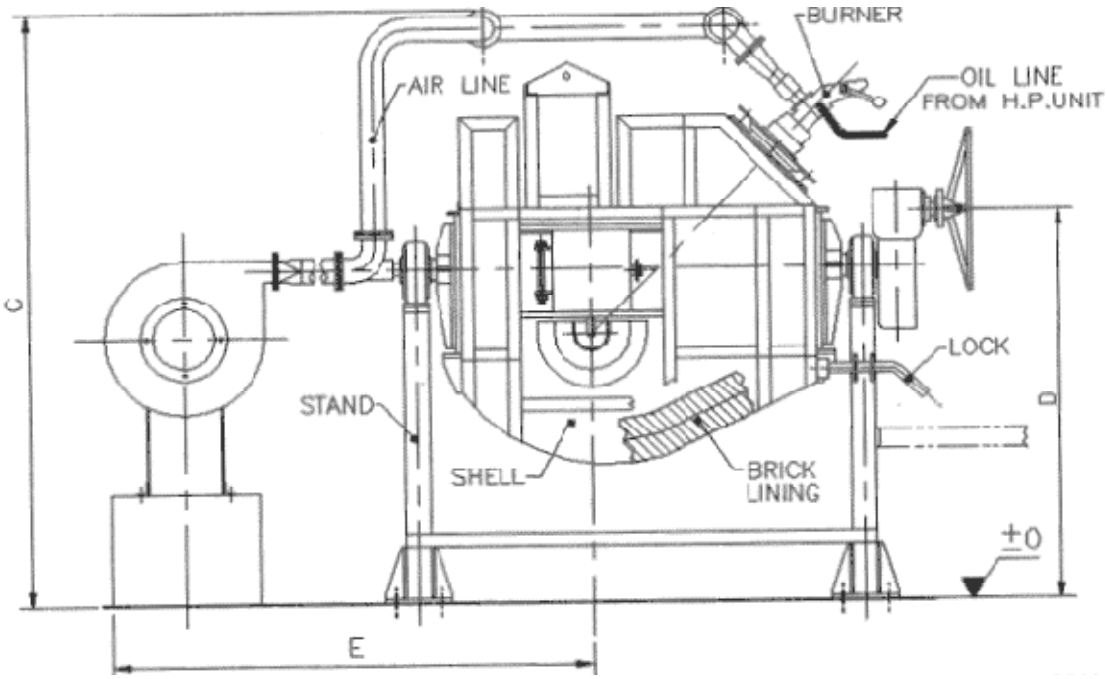
There is a tremendous need for this industry to modernize/upgrade its technology and adopt energy efficient technologies in some of the areas. Further, as per the discussions made with the some of the progressive managements, they are interested in improve the efficiency their units by replacing the conventional technology with energy efficient technologies in market.

The various factors which influence the management towards implementation energy efficiency and energy conservation projects in brass unit in Jamnagar Brass Cluster are:

- Energy efficiency and energy conservation is a low cost investment option which reduces energy consumption
- Low capital investment
- The energy efficiency improvement will enhance the plant management to be competitive in local and global markets by reducing production cost
- To conserve depleting fossil fuels
- The energy efficiency and conservation reduces GHG emissions because of low carbon dioxide and particulate emissions
- Energy efficiency and conservation is a viable strategy to meet future energy needs of the expanding plans in the industry
- The energy efficiency and conservation places no financial and administrative burden as no separate manpower is required and only training of operation and maintenance of the technologies adopted is envisaged

S. No.	Parameter	Units	Value
1	Total Material Melt	Kg	255
2	Total Fuel Consumption	Kg	49
3	Specific fuel consumption	kg/tonne	192.16
4	Fuel consumption in proposed furnace	kg/tone	45
5	Density of gas	m3/kg	0.80
6	Gas consumption in proposed furnace	m3/tonne	56.25
7	Efficiency of rotoberatory furnace (Based on fuel consumption mention in the vendor quotation)	% age	31
8	Cost of coal	Rs/kg	18
9	Cost of gas	Rs/m3	24
10	Cost of fuel (Coal) in existing furnace	Rs/tone	3459
11	Cost of fuel (Gas) in proposed furnace	Rs/tone	1350
12	Cost benefit due to fuel change	Rs/tone	2109
13	Total operating hours	hrs	2000
14	Total Batch time	hrs	1.5
15	Total production	Tone/year	1000
16	Total coal consumption in base case	tons	192
17	Total gas consumption in proposed case	m3	56250
18	Total connected load	HP	2
19	Total Electricity consumption	kWh	2984
20	Cost of electricity consumption @ 5/kWh	₹	14920
21	Total monetary benefit	₹in lakh	20.94
22	Cost of project	₹	20.63
23	Simple payback period	years	0.99

Annexure-4 Detailed cash flow evaluations



Annexure-5:Detailed cash flow evaluations

Name of the Technology	*Gas Fired rotoberatory Furnace*		
Rated Capacity	*750 kg/hr*		
Details	*Unit*	*Value*	*Basis*
Installed Capacity	Kg/hr	750	
Total operating hours	Hrs	2000	
Total production	Tons	1000	
Proposed Investment			
Cost of plant & Machinery	₹(in lakh)	18.75	Feasibility Study
Erection & Commissioning	₹(in lakh)	1.88	Feasibility Study
Total Investment	₹(in lakh)	20.63	Feasibility Study
Financing pattern			
Own Funds (Internal Accruals)	₹(in lakh)	5.16	Feasibility Study
Loan Funds (Term Loan)	₹(in lakh)	15.47	Feasibility Study
Loan Tenure	Years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%	10.00	SIDBI Lending rate
Estimation of Costs			
O& M Costs	%(on Plant & Equip)	4.00	Feasibility Study
Annual Escalation	%	5.00	Feasibility Study
Estimation of Revenue			
Fuel savings	₹/Tonne	2109	-
Annual production	Tonne/Annum	1000	-
Electricity consumption	kWh/Year	2984	-
Cost	₹/kWh	5	-
St. line Depreciation	%	5.28	Indian Companies Act
IT Depreciation	%	80.00	Income Tax Rules
Income Tax	%	33.99	Income Tax Act 2008-09

Estimation of Interest on term loan ***₹(in lakh)***

Years	Opening Balance	Repayment	Closing Balance	Interest
1	15.47	1.20	14.27	1.78
2	14.27	2.40	11.87	1.32
3	11.87	2.64	9.23	1.07
4	9.23	3.00	6.23	0.79
5	6.23	3.80	2.43	0.46
6	2.43	2.43	0.00	0.07
		15.47		

WDV Depreciation ***₹(in lakh)***

Particulars / years	*1*	*2*
Plant and Machinery		
Cost	20.63	4.13
Depreciation	16.50	3.30
WDV	4.13	0.83

Projected Profitability

₹ (in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Revenue through Savings								
Fuel savings	20.94	20.94	20.94	20.94	20.94	20.94	20.94	20.94
Total Revenue (A)	20.94	20.94	20.94	20.94	20.94	20.94	20.94	20.94
Expenses								
O & M Expenses	0.83	0.87	0.91	0.96	1.00	1.05	1.11	1.16
Total Expenses (B)	0.83	0.87	0.91	0.96	1.00	1.05	1.11	1.16
PBDIT (A)-(B)	20.12	20.07	20.03	19.99	19.94	19.89	19.84	19.78
Interest	1.78	1.32	1.07	0.79	0.46	0.07	-	-
PBDT	18.33	18.76	18.96	19.20	19.47	19.81	19.84	19.78
Depreciation	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
PBT	17.24	17.67	17.88	18.11	18.39	18.72	18.75	18.69
Income tax	0.62	5.25	6.45	6.53	6.62	6.73	6.74	6.72
Profit after tax (PAT)	16.62	12.41	11.43	11.58	11.77	11.99	12.00	11.97

Computation of Tax

₹ (in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit before tax	17.24	17.67	17.88	18.11	18.39	18.72	18.75	18.69
Add: Book depreciation	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Less: WDV depreciation	16.50	3.30	-	-	-	-	-	-
Taxable profit	1.83	15.46	18.96	19.20	19.47	19.81	19.84	19.78
Income Tax	0.62	5.25	6.45	6.53	6.62	6.73	6.74	6.72

Projected Balance Sheet

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Liabilities								
Share Capital (D)	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.16
Reserves & Surplus (E)	16.62	29.03	40.46	52.05	63.81	75.80	87.81	99.78
Term Loans (F)	14.27	11.87	9.23	6.23	2.43	0.00	0.00	0.00
TOTAL LIABILITIES (D)+(E)+(F)	36.04	46.06	54.85	63.43	71.40	80.96	92.96	104.93
Assets								
Gross Fixed Assets	20.63	20.63	20.63	20.63	20.63	20.63	20.63	20.63
Less Accm. depreciation	1.09	2.18	3.27	4.36	5.45	6.53	7.62	8.71
Net Fixed Assets	19.54	18.45	17.36	16.27	15.18	14.09	13.00	11.91
Cash & Bank Balance	16.51	27.61	37.49	47.16	56.22	66.87	79.96	93.02
TOTAL ASSETS	36.04	46.06	54.85	63.43	71.40	80.96	92.96	104.93
Net Worth	21.78	34.19	45.62	57.20	68.97	80.96	92.96	104.93
Debt Equity Ratio	2.77	2.30	1.79	1.21	0.47	0.00	0.00	0.00

Projected Cash Flow: ***₹ (in lakh)***

Particulars / Years	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Sources									
Share Capital	5.16	-	-	-	-	-	-	-	-
Term Loan	15.47								
Profit After tax		16.62	12.41	11.43	11.58	11.77	11.99	12.00	11.97
Depreciation		1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Total Sources	20.63	17.71	13.50	12.52	12.67	12.85	13.08	13.09	13.06
Application									
Capital Expenditure	20.63								
Repayment Of Loan	-	1.20	2.40	2.64	3.00	3.80	2.43	-	-
Total Application	20.63	1.20	2.40	2.64	3.00	3.80	2.43	-	-
Net Surplus	-	16.51	11.10	9.88	9.67	9.05	10.65	13.09	13.06
Add: Opening Balance	-	-	16.51	27.61	37.49	47.16	56.22	66.87	79.96
Closing Balance	-	16.51	27.61	37.49	47.16	56.22	66.87	79.96	93.02

IRR **₹ (in lakh)**

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit after Tax		16.62	12.41	11.43	11.58	11.77	11.99	12.00	11.97
Depreciation		1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Interest on Term Loan		1.78	1.32	1.07	0.79	0.46	0.07	-	-
Cash outflow	(20.63)	-	-	-	-	-	-	-	-
Net Cash flow	(20.63)	19.49	14.82	13.59	13.46	13.32	13.15	13.09	13.06
IRR	79.18%								

NPV	57.25

Break Even Point

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.62	0.65	0.68	0.72	0.75	0.79	0.83	0.87
Sub Total*(G)*	0.62	0.65	0.68	0.72	0.75	0.79	0.83	0.87
Fixed *Expenses*								
Oper. & Maintenance Exp (25%)	0.21	0.22	0.23	0.24	0.25	0.26	0.28	0.29
Interest on Term Loan	1.78	1.32	1.07	0.79	0.46	0.07	0.00	0.00
Depreciation *(H)*	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Sub Total (I)	3.08	2.62	2.38	2.11	1.80	1.43	1.37	1.38
Sales (J)	20.94	20.94	20.94	20.94	20.94	20.94	20.94	20.94
Contribution (K)	20.32	20.29	20.26	20.22	20.19	20.15	20.11	20.07
Break Even Point (L= G/I)	15.16%	12.93%	11.76%	10.45%	8.93%	7.08%	6.79%	6.87%
Cash Break Even {(I)-(H)}	9.80%	7.56%	6.39%	5.07%	3.54%	1.67%	1.37%	1.45%
Break Even Sales (J)*(L)	3.17	2.71	2.46	2.19	1.87	1.48	1.42	1.44

Return on Investment **₹ (in lakh)**

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Net Profit Before Taxes	17.24	17.67	17.88	18.11	18.39	18.72	18.75	18.69	145.44
Net Worth	21.78	34.19	45.62	57.20	68.97	80.96	92.96	104.93	506.62
									28.71%

Debt Service Coverage Ratio ***₹ (in lakh)***

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Cash Inflow									
Profit after Tax	16.62	12.41	11.43	11.58	11.77	11.99	12.00	11.97	75.80
Depreciation	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	6.53
Interest on Term Loan	1.78	1.32	1.07	0.79	0.46	0.07	0.00	0.00	5.49
Total (M)	19.49	14.82	13.59	13.46	13.32	13.15	13.09	13.06	87.83

DEBT

Interest on Term Loan	1.78	1.32	1.07	0.79	0.46	0.07	0.00	0.00	5.49
Repayment of Term Loan	1.20	2.40	2.64	3.00	3.80	2.43	0.00	0.00	15.47
Total (N)	2.98	3.72	3.71	3.79	4.26	2.50	0.00	0.00	20.96
Average DSCR (M/N)	4.19								

Annexure-6 Details of procurement and implementation plan

Procurement and implementation schedule of energy efficient gas fired rotoberatory furnace are presented below.

Activity	Weeks												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Energy data reconfirmation													
Technical discussion & finalization													
Collection of vendor quotes													
Order placement													
Material receipt													
Installation & Commissioning													
Measurement of savings													
Certification of savings													

Annexure-7 Details of equipment and service providers

Name of company	Micro Hydraulic
Advanced Heating Systems	207, Vandaman Complex 8, Facilty Center, Mayapuri Phase-II, New Delhi 110064, Phone no. : 91-011-28112315, 32914872 +91-09810520120 Email : services@advance-systems.in, sales@advance-systems.in

Annexure 8 Quotations of energy efficient rotoberatory furnace

TECH EXCELLENCE

Quotation Of 750 Kgs Green Smelter – A Rotoberatory Furnace

Technical Specification For Green Smelter

Equipment	:	Rotoberatory Tilting Type Melting Furnace
Capacity	:	750kg/Batch
Outer Size	:	length x Height x width
		1500 x 1500 mm
Operating Temp.	:	1050° C
Max. Temp.	:	1350° C
Oil consumption	:	50-55ltrs/ton
Fuel	:	FO/LDO/LPG/ NATURAL GAS.
LPG Bank	:	50 cylinder bank (40-45 kg/batch)
Melting Time	:	1.5Hour/batch
Blower	:	2 H.P
Ignition	:	Manual
Temp Control	:	Automatic
Tilting System	:	Mechanical
Door Operation	:	Manual (Rise & Fall)
Recuperator	:	5 HT

SCOPE OF SUPPLY

The scope will cover design, Engineering, Manufacturing, Supply, Erection & Commissioning of the above furnace consisting of the following: -

Furnace Shell

The outer shell / casing of the furnace will be CIRCULAR type in shape fabricated out of 5-6 MM thick Rolled Milled steel plates duly reinforced with adequate Channel and Angle for rigidity and sturdy construction. The construction of shell would be such that it can with stand operational stresses and thermal expansion that may develop due to high operating temperature.

Refractory Lining

The exposed layer of the main furnace shell will have 115 MM H.A.-75% Fire Bricks. Backed up with 115 MM I.S.-8 Fire Bricks, 75 mm Insulation Bricks & further backed up with 25 mm Hysil block with 5mm mill board. Roof lining 300 mm Ceramic fiber with SS strips and bar.

Air & Gas Pipe Line

Our scope of supply shall include complete Air Line from Blower to Burners and Gas line from Gas Train to Burners along with fittings.

Price Rs. 18,75,000=/

Terms & Conditions

Payment Terms :

50% advance with Purchase order and declaration form.

20% before dispatch.

20% after Refractory works

10% after successful commissioning.

Taxes :

Sale Tax / VAT	:	As Applicable
Cartage	:	To Pay
Packing Charges	:	Extra
Delivery Period	:	5 To 6 Weeks

General :

- All Civil Foundation works will be carried out by you as per our design.
- Electrical Cable, Panel & Connection upto our panel board will be provided by you.
- Machinery Required for erection i.e. Welding set, Cutting set, Tools & Tackles
- Cranes for unloading etc. will be provided by you.
- Lodging & boarding for our Erection Team will be arranged & borne by you.
- You would provide all above at your own cost.
- Cost of LPG bank would be given separately, depending on the distance & space available at site.

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Website: www.winrockindia.org

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